

CLAIMS

1. A hollow fiber membrane cartridge, having one or more hollow fiber membrane bundles each comprising a plurality of hollow fiber membranes and having opposite ends fixedly bonded by an adhesion fixation layer, a cartridge head fixed to an outer periphery of one end of the hollow fiber membrane bundles in a liquid tight manner, and a lower ring fixed to an outer periphery of the other end of the hollow fiber membrane bundles,

wherein a hollow portion of each of the hollow fiber membranes is opened at the cartridge head-side end of the cartridge, the hollow portion of the hollow fiber membrane is sealed in a lower ring-side adhesion fixation layer, and a plurality of through-holes are formed in the lower ring-side adhesion fixation layer, and wherein the through-holes are arranged in the hollow fiber membrane bundle, an end of the lower ring projects from an end surface of the lower ring-side adhesion fixation layer, and at least part of the hollow fiber membrane bundles are divided into at least two, plural small bundles in the cartridge head-side adhesion fixation layer.

2. The hollow fiber membrane cartridge according to claim 1, wherein at least part of the hollow fiber membrane bundles are divided into at least two, plural small bundles between the lower ring-side adhesion fixation layer and the cartridge head-side adhesion fixation layer.

3. The hollow fiber membrane cartridge according to claim 1, wherein in each of the small bundles of hollow fiber membranes at a filtration section-side interface of the cartridge head-side adhesion fixation layer, a distance between the hollow fiber membranes located closest to each other is less than 2 mm, the number of hollow fiber membranes is at least 10 and at most 1,000, and a distance between the small bundles located closest to each other is at least 2 mm and at most 100 mm.

4. The hollow fiber membrane cartridge according to claim 1, wherein the small bundles of hollow fiber membranes at the filtration section-side interface of the cartridge head-side adhesion fixation layer are arranged on one or more concentric circles.

5. The hollow fiber membrane cartridge according to claim 4, wherein the hollow fiber membrane bundles are present in all directions from a central portion to outer peripheral portions of the concentric circles of the filtration section-side interface of the cartridge head-side adhesion filtration layer.

6. The hollow fiber membrane cartridge according to claim 1, wherein a resin forming the filtration section-side interfaces of the cartridge head- and lower ring-side adhesion fixation layers has a hardness (measured in conformity with JISK6253 and ISO7619) of at least 20A and at most 90A.

7. A membrane separation device wherein the

hollow fiber membrane cartridge according to any of claims 1 to 6 is placed vertically in a container having an inlet port, and a gas input port is formed at a bottom of the lower ring of the hollow fiber membrane cartridge so that during filtration and/or back wash reverse filtration, a gas is injected from the gas input port and passes through the plurality of through-holes in the lower ring-side adhesion fixation layer to oscillate the hollow fiber membranes.

8. A membrane separation method comprising introducing raw water to be treated into a container and carrying out suction filtration and back wash reverse filtration while aerating a bottom of the lower ring of the hollow fiber membrane cartridge according to any of claims 1 to 6 and arranged vertically in the container.